METER LAB

DIGIEC

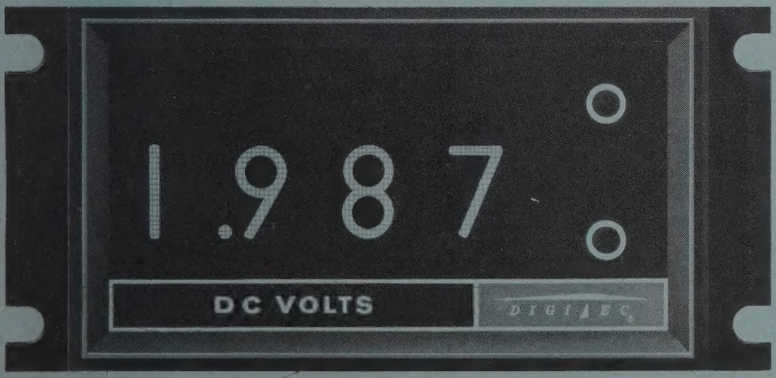
DIGITAL PANEL METER INSTRUCTION MANUAL

MI-1110

For Models

271-1, 271-2, 271-3, 271-4, 271-5,

272-1, 272-2, 272-3, 272-4, 272-5



UNITED SYSTEMS CORPO

918 WOODLEY ROAD/DAYTON, OHIO 454

MP MASTER
MA26222

UNPACKING AND SHIPPING

After unpacking, carefully examine the instrument for physical damage that may have occurred in transit. If any damage is noted, immediately contact United Systems Corporation for further instructions.

If it should become necessary to return the instrument to United Systems Corporation, make certain that at least four inches of padding material surrounds the instrument to prevent damage during shipment. When returning instruments to the factory, give a full description of the failure of the instrument and the mode of operation that was used when the instrument failure occurred. Ship via REA Express, motor truck, or air freight PREPAID to:

United Systems Corporation
918 Woodley Road
Dayton, Ohio 45403

For foreign countries: Please contact your local representative for instructions.

WARRANTY

"UNITED SYSTEMS CORPORATION guarantees all instruments and accessories to be free from defects in material and workmanship, when subjected to normal use and service. This guarantee is expressly limited to the servicing and/or adjusting of an instrument returned, freight prepaid, to the factory within one (1) year from date of delivery; and to the repairing, replacing or adjusting of parts (excepting lamps and fuses) which upon examination shall be found defective. UNITED SYSTEMS CORPORATION assumes no liability in connection with the sale of such products beyond that specifically provided hereinabove."

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Digital Panel Meter
Instruction Manual
MI-1110

FOR MODELS
271-1, 271-2, 271-3, 271-4, 271-5,
272-1, 272-2, 272-3, 272-4, 272-5.

1. GENERAL INFORMATION

The DigiTec Series 270 Readouts are precision, miniature digital instruments. They are capable of accurately indicating any measurable parameter that is expressed by, or can be transduced into, a DC voltage or current.

1.a Features

Models of these digital readouts are available for a wide range of voltages and currents with resolution as low as 100 microvolts or 10 nanoamps. Other important features are:

High accuracy
Non-blinking display
100 Megohm input impedance
BCD option
Reading retention
Small panel space
Completely self contained

1.b Applications

Some of the typical applications for the Series 270 are:

Replacement of moving coil meters
Monitoring voltage or current
Output indicators for signal conditioners for such parameters as pressure, strain or temperature
Analog to digital conversions for use with printer, punches or process control.

1.c Technical Specifications

Range		Model No.	Resolution	Input Impedance	Accuracy
Millivolts	000.0-199.9	271-1	100 μV	100MΩ	0.1% of reading ±1 digit
Volts	0.000-1.999	271-2	1 mV	100MΩ	
	00.00-19.99	271-3	10mV	10MΩ	
	000.0-199.9	271-4	100 mV	10MΩ	
	0000.-1000.	271-5	1 V	10MΩ	
				Shunt Impedance	0.2% of reading ± 1 digit
Microamperes	00.00-19.99	272-1	10 nA	10KΩ	
	000.0-199.9	272-2	.1 μA	1KΩ	
	0.000-1.999	272-3	1 μA	100Ω	
Milliamperes	00.00-19.99	272-4	10 μA	10Ω	
	000.0-199.9	272-5	.1 mA	1Ω	

Reading Time	0.5 sec. maximum to 99.9% rated accuracy
Reading Rate	60 readings per second
Display	Ultra long life NIXIES®
Error Lamp	Indicates over range or reverse polarity input
Isolation	500 VDC, input low to ground
Rejection	Normal Mode 40 db @ 60 Hz Common Mode 80 db
Reading Retention	Circuit opening to hold indefinitely
Overload Protection	± 100 volts on Models 271-1 & 271-2 ± 1000 volts on Models 271-3, 271-4 & 271-5 1 watt dissipation for Models 272-1, 2, 3, 4, & 5
BCD output ('N' Option)	
Logic	
1	+3.0V @ 400 μA typical
0	0 to .4 volt, current sink = 4.4ma typical
Error	+3.0V coincident with visual indication
Power Requirements	105/125V 50/60Hz, 5.5VA 210/250V ('S' Option)
Net Weight	1 pound 9 ounces
Shipping Weight	2-1/4 pounds
Output Connector	Cinch 251-12-36-160 (furnished)

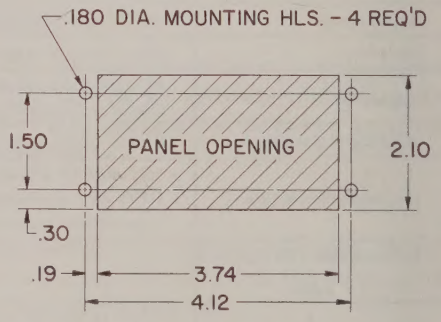
1.d Precautions

The rear connector is keyed with the pin numbers on top. Failure to mount the connector correctly may result in permanent damage to the instrument. To operate these instruments, earth ground as well as high and low power must be supplied to the connector. Unstable readings may occur if the earth ground connection is deleted.

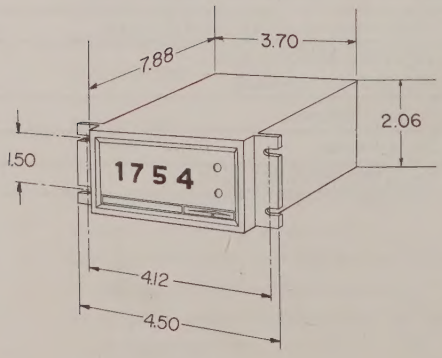
These instruments incorporate a 'store' feature that may be used to retain a digital reading. This feature must be defeated with a jumper for normal operation (See Section 3.b).

2. INSTALLATION

These instruments are designed to be permanently mounted into a panel using No. 6 Screws or Studs. The instrument must be inserted into the cutout from the rear. Figure 1 illustrates the instrument opening and mounting dimensions, while Figure 2 illustrates the over all dimensions.



Panel Template
Figure 1

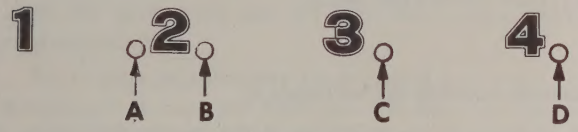


Outline Drawing
Figure 2

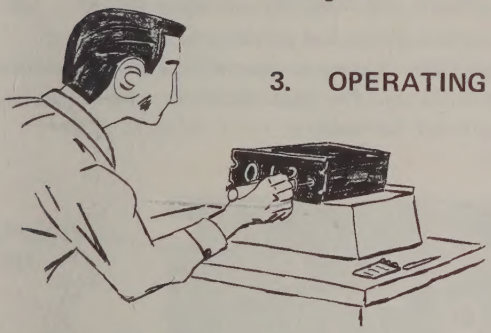
2.a Decimal Point Selection

Decimal points are factory installed in the location designated by the model number. It is strongly recommended that the decimal point not be changed in the field; however, it can be changed if extreme caution is observed. The decimal point can be in any one of four positions: A, B, C or D (See Figure 3).

To change the decimal point location, remove the solder from the undesired pad location A, B, C or D (see Figure 8, View 3) with a small, low temperature iron and apply a drop of solder to the pad corresponding to the new decimal location.



Decimal Point Position
Figure 3



3. OPERATING INSTRUCTIONS

3.a Power Connection

The power applied to these digital readouts can be either 115 or 230 VAC, depending on internal connections made at the factory. Units wired for 230 volt operation are designated with an 'S' suffix. For either input voltage, Pin 'A' is power high, Pin 'B' is power low and Pin '2' is earth ground. Readings may be unstable if earth ground is not used.

3.b Reading Retention

Some applications, such as recording of data, require that the normal sampling rate be interrupted and the last digital reading stored. This can be accomplished by opening the connection between Pins 1 (store) and 2 (common) of the rear connector.

3.c Warm-up Period

For maximum accuracy, these instruments should be allowed to warm up for 20 minutes. The instrument, however, is operable immediately upon turn-on with a stabilization error of approximately one digit.

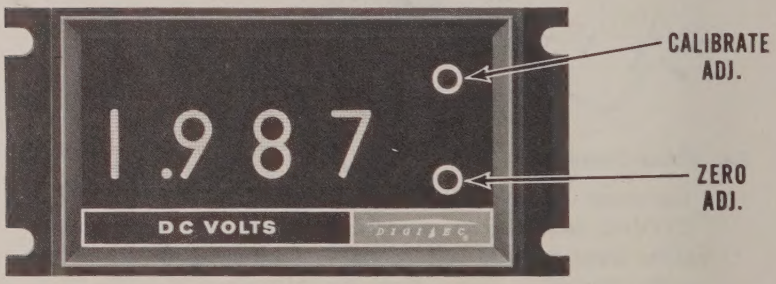
3.d Zero Adjustment (See Figure 4)

The zero adjustment, located on the front panel, is used to zero out internal offsets in the instrument and offset voltages that may be present in the input signal.

3.e Calibrate Adjustment (See Figure 4)

All instruments are calibrated at the factory to meet or exceed the specification outlined in Section 1.c of this manual. If recalibration is desired, the following procedure should be used.

1. Allow 20 minutes warm up and adjust zero.
2. Apply full scale input voltage or current to Pins 12 (positive) and 11 (negative) on the rear connector and adjust the calibrate control for full scale.
3. Recheck zero



Front View of Instrument
Figure 4

4. CIRCUIT DESCRIPTION (See Figure 6)

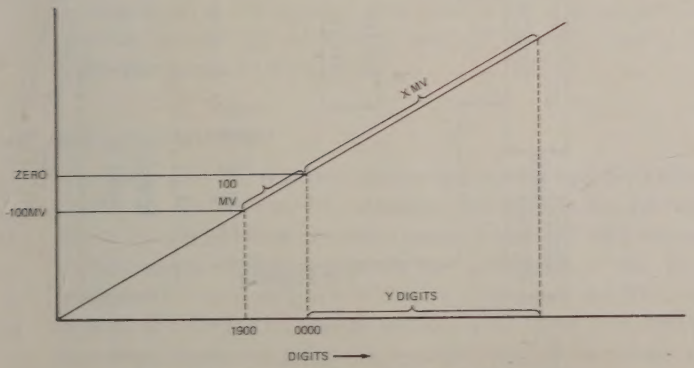
At the beginning of a sampling cycle, a ramp gate is initiated and the solid state switch is set to monitor the internal reference voltage. The ramp gate initiates a ramp voltage and a reset pulse.

The ramp voltage is fed to a detector where it is compared to a reference voltage and the reset pulse is used to preset the digital section to 1900.

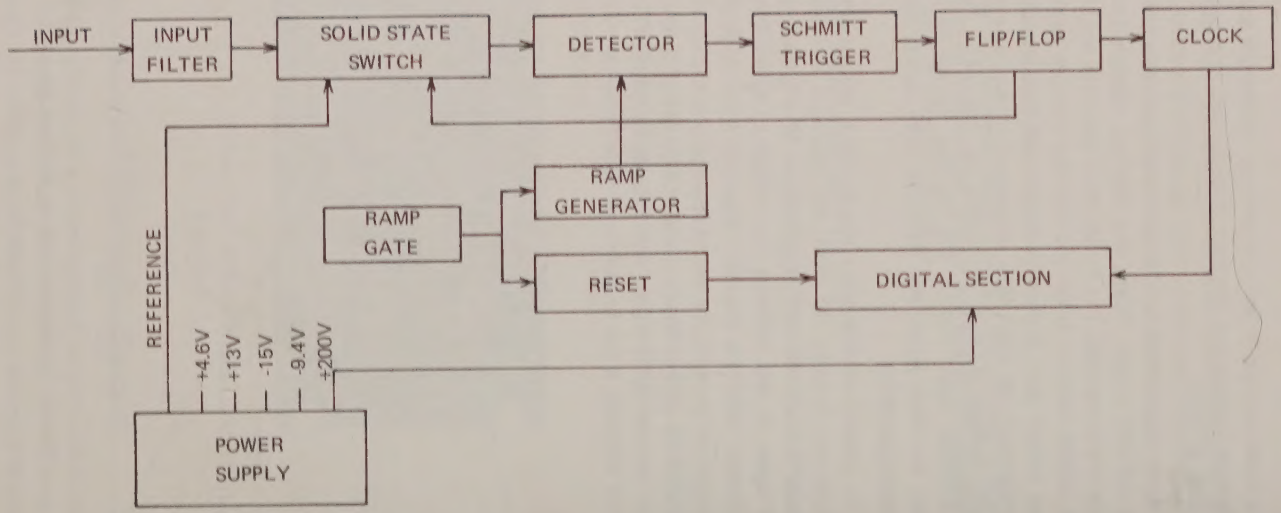
When coincidence of the reference and ramp voltage occurs, the Schmitt trigger 'fires', the flip-flop changes state, and the clock starts running. The pulses from the clock are then fed into the digital section. When the flip-flop changes states, the solid state switch also changes positions and begins monitoring the voltage from the input filter instead of the reference voltage. This input voltage is now compared to the same ramp. When coincidence again occurs, the flip-flop returns to the original state, the clock stops, and the solid state switch returns to the reference position.

To provide an extremely stable digital instrument, the same comparator is used for both the reference and the unknown voltage. Since a Schmitt trigger cannot 'fire' reliably at zero volts and again at one millivolt, the reference is set at minus 100 millivolts, with the counter preset to 1900 digits. Using this arrangement an artificial but highly stable zero will be produced. Since minus 100 millivolts equals 1900 digits, zero volts can be made to read 2000 digits which resets to 0000. Then by using similar triangles, it can be seen that: (See Figure 5)

$$\frac{\text{100MV}}{\text{100 Digits}} = \frac{\text{X MV}}{\text{Y Digits}}$$



Graphic Representation of Artifical Zero
Figure 5



Block Diagram
Figure 6

4.a Input Filter

The input filter consists of a two section R-C circuit. A clipper diode is used to limit the positive voltage to a safe level for over-voltage protection.

4.b Solid State Switches

The solid state switches consists of two field effect chopper transistors, Q24 and Q23. The transistors are arranged so that one transistor monitors the input voltage while the other monitors the reference voltage. The transistor that is 'on' at any specific time is determined by the status of the flip-flop.

4.c Detector

The detector consists of a single PNP transistor which compares the input and reference voltage to the ramp voltage. When coincidence occurs an output is produced which is fed to the Schmitt trigger.

4.d Schmitt Trigger

The Schmitt trigger, preceded by emitter follower Q19, consists of transistors, Q17 and Q18. When Q18 is 'on', Q17 will be 'off'. For each turn-off of Q17 the flip-flop changes states.

4.e Flip-Flop

The flip-flop consists of Q15, Q16 and associated components. When Q16 is 'off', the FET chopper, Q21, is 'on' and the input voltage is fed to the detector. When Q15 is 'off', the chopper Q23 will be 'on' and Q21 will be turned 'off', thereby, feeding the reference voltage to the detector.

4.f Ramp Gate and Reset

The ramp gate and reset are initiated every other half cycle of the 50/60 Hz power line. The transistor Q3 receives a pulse from diode D7 and produces an output which drives Q22. Q22 acts as a switch across C16 and controls the generation of the ramp voltage. This ramp voltage is initiated continuously at a 60Hz rate as long as a jumper is installed between Pins 1 and 2 on the rear terminals. When this jumper is removed, Q4 will be turned 'on' which turns Q3 'on' and Q22 'off', thus preventing a new ramp voltage from being generated.

The reset is used to preset the digital section at the beginning of a sampling cycle. The reset pulse is derived by differentiating the ramp gate with C1, R6, and Q2.

4.g Ramp Generator

The ramp generator consists of a high gain operational amplifier with capacitive feedback. The amplifier then acts as an integrator, thus converting a constant current into a highly linear ramp voltage.

4.h Clock

The clock consists of a gated Colpitts oscillator, a buffer and final amplifier stage. The oscillator is turned on when Q15, in the flip-flop section, is off; thus, allowing the clock to be operable only when the solid state switch is monitoring the input voltage.

4.i Digital Section

The digital section consists of integrated circuit BCD counters, BCD to decimal converters, Nixie tubes, and drivers for the error and 1000 bit indicators. The output from the clock is fed into the BCD counter which converts the incoming 'clock' pulses into BCD logic output. The BCD output is then decoded into decimal information and displayed on the Nixie tubes. The 1000 digit and error bit consists of neon lamps driven by discrete transistors.

4.j Power Supply

There are five power supplies in this instrument. The most important supply is the minus 9.4 volt source which is used to reference the -15 and +4.5 volts supplies as well as providing a stable reference for zero.

The +13 volt supply uses a simple R-C filter with a zener diode in the output.

The +200 volt supply uses only a single diode and produces half wave pulsating DC. This half wave DC allows the counters to count without displaying on the negative half cycle, and to display the stored digital reading on the positive half cycle.

5. REAR CONNECTOR (Cinch 251-12-36-100)

Function	Pin
Input (positive)	12
Signal ground (negative)	11
High line	A
Low line	B
Earth ground	C
Store	1
Common	2
Not connected	3, 4, D

Function	Pin
'N' Option Only	
BCD 1	5
BCD 2	6
BCD 4	F
BCD 8	E
BCD 10	H
BCD 20	J
BCD 40	8
BCD 80	7
BCD 100	K
BCD 200	10
BCD 400	L
BCD 800	9
BCD 1000	N
BCD Error	M
BCD Common	2

6. SERVICE AND TROUBLESHOOTING

6.a Necessary Service Equipment

1. A standard VTVM of 3% accuracy or better.
2. An oscilloscope capable of measuring 550KHz.
3. Voltage or current standard with accuracy of 0.01% or better.

If service equipment of the required accuracy is not available, the instrument may be returned to United Systems Corporation for repair.

6.b Repair Procedure

The Series 270 instruments have extremely high input impedance. To maintain this impedance, and thus the stability of the instrument, the printed circuit board must be thoroughly cleaned and coated after any repair in the input circuitry. To make any repairs in this section, the following procedure must be used.

1. Remove the plastic coating from the board with Methylene Chloride.
2. Make repairs as necessary with a small low temperature iron.
3. Clean board – protect pots to prevent removal of lubricants.
   (a) Salt base fluxes – wash with three changes of warm water or one long cycle of a board washer.
   (b) Resin flux – remove with Toluol or Trichlorethelene.
4. Clean board with Freon TE.
5. Spray with Urethene seal coat (CRC No. 2049 or equivalent).
6. Wait 24 hours before reapplying power to board.

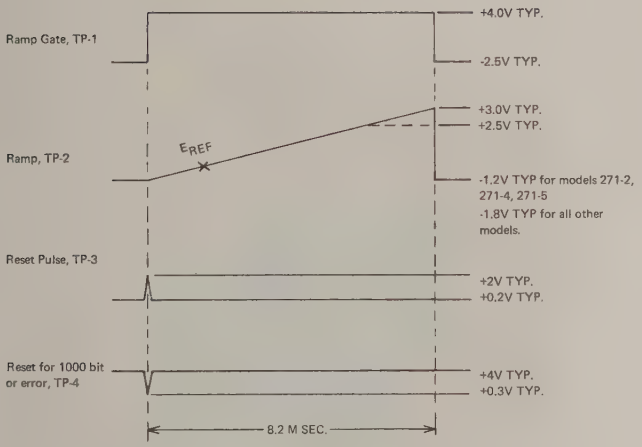
6.c Fuse Replacement

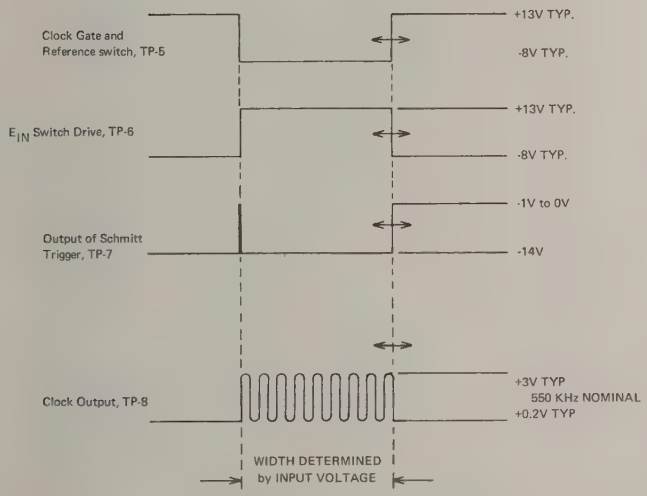
This instrument contains a 1/4 amp fuse, (1/8 amp for 'S' suffix) which may fail as a result of severe line transients or by component failure within the instrument. If the replacement fuse fails, the circuit should be checked thoroughly. A HIGHER CURRENT FUSE SHOULD NEVER BE SUBSTITUTED. The fuse is located on the transformer using pigtailed leads.

6.d TROUBLESHOOTING HINTS

Symptoms	Possible Cause
Unit will not sample	Defective Q4, Q3, Q22
All numbers in Nixie lit simultaneously	Defective Q2, IC2, 3, 4
Incorrect number displayed	IC 2, 3, 4, 6, 7, 8
Error lamp inoperative	IC5, Q1, L1
1000 Bit lamp inoperative	IC5, Q5, L2

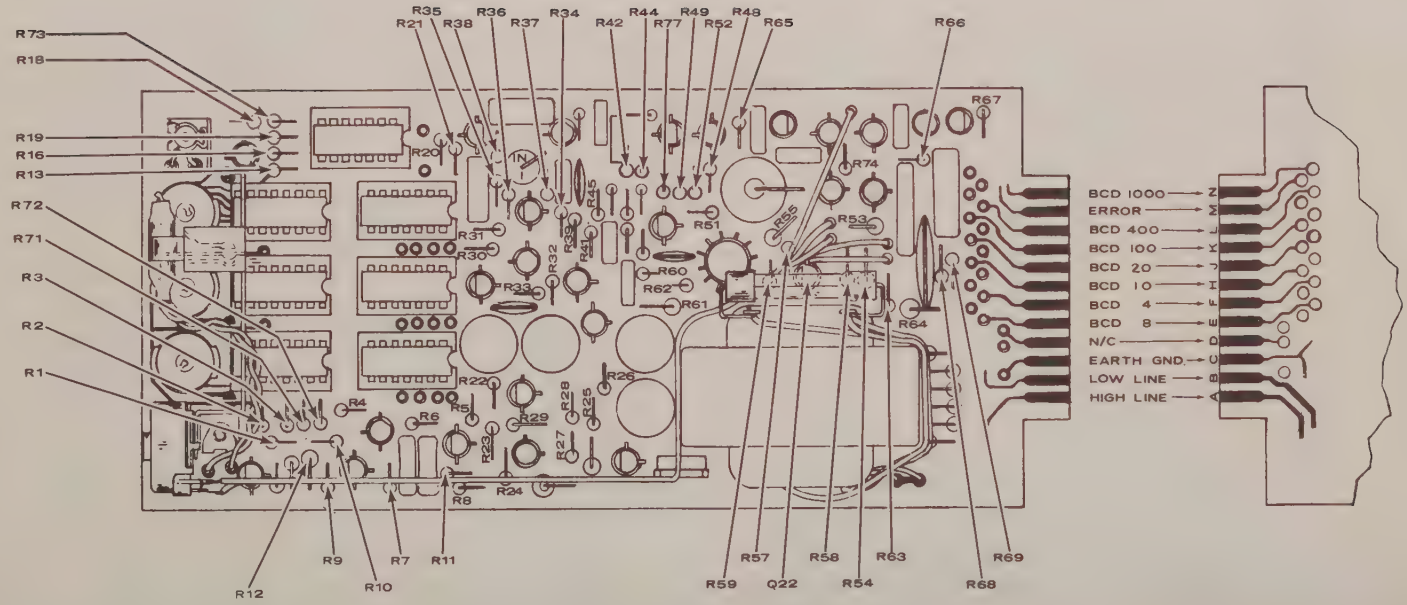
It is not recommended that Nixie tubes be replaced in the field. For typical waveshapes and voltages, see Figure 7.



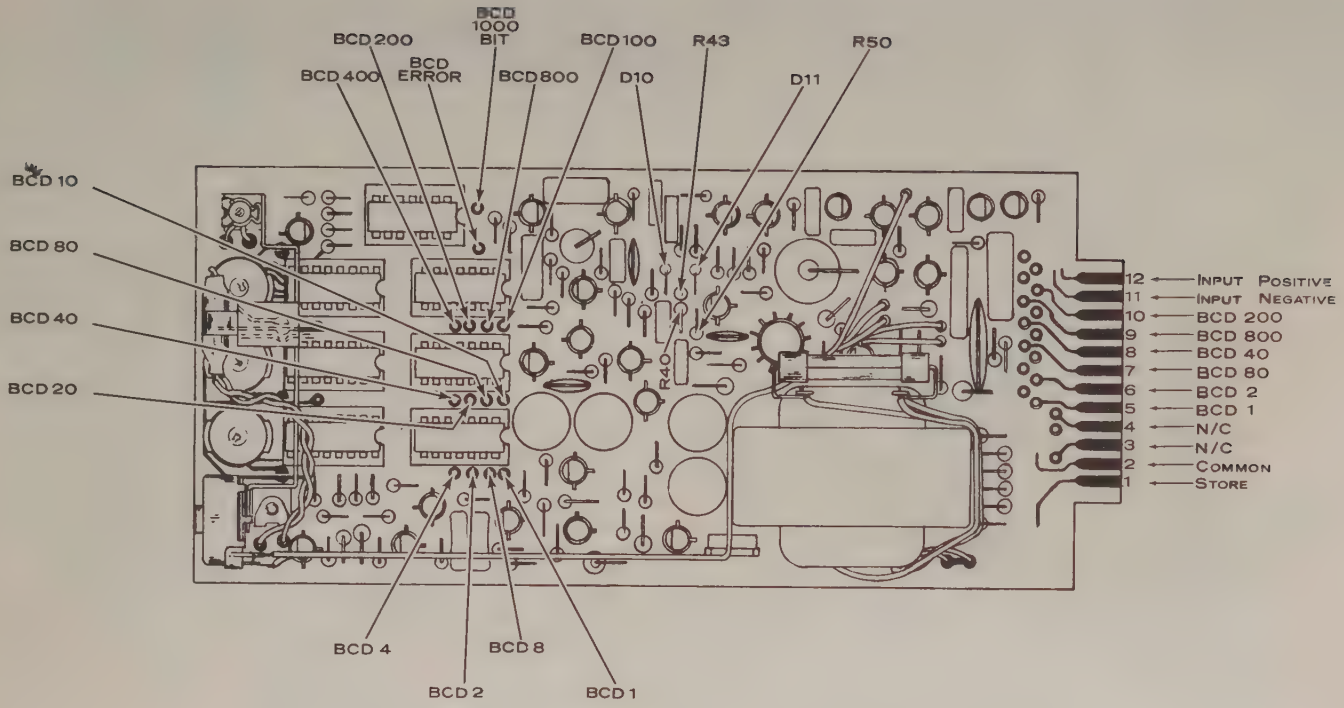


	TYPICAL	RANGE
TP- 9	- 15.0 Volts	14.5 to 15.5
TP-10	+ 4.6 Volts	4.2 to 4.8
TP-11	+13.0 Volts	11.5 to 14.5
TP-12	+ 9.4 Volts	9.2 to 9.6
TP-13	+238V Peak	170 to 270

Typical Test Point Waveforms and Voltages
Figure 7

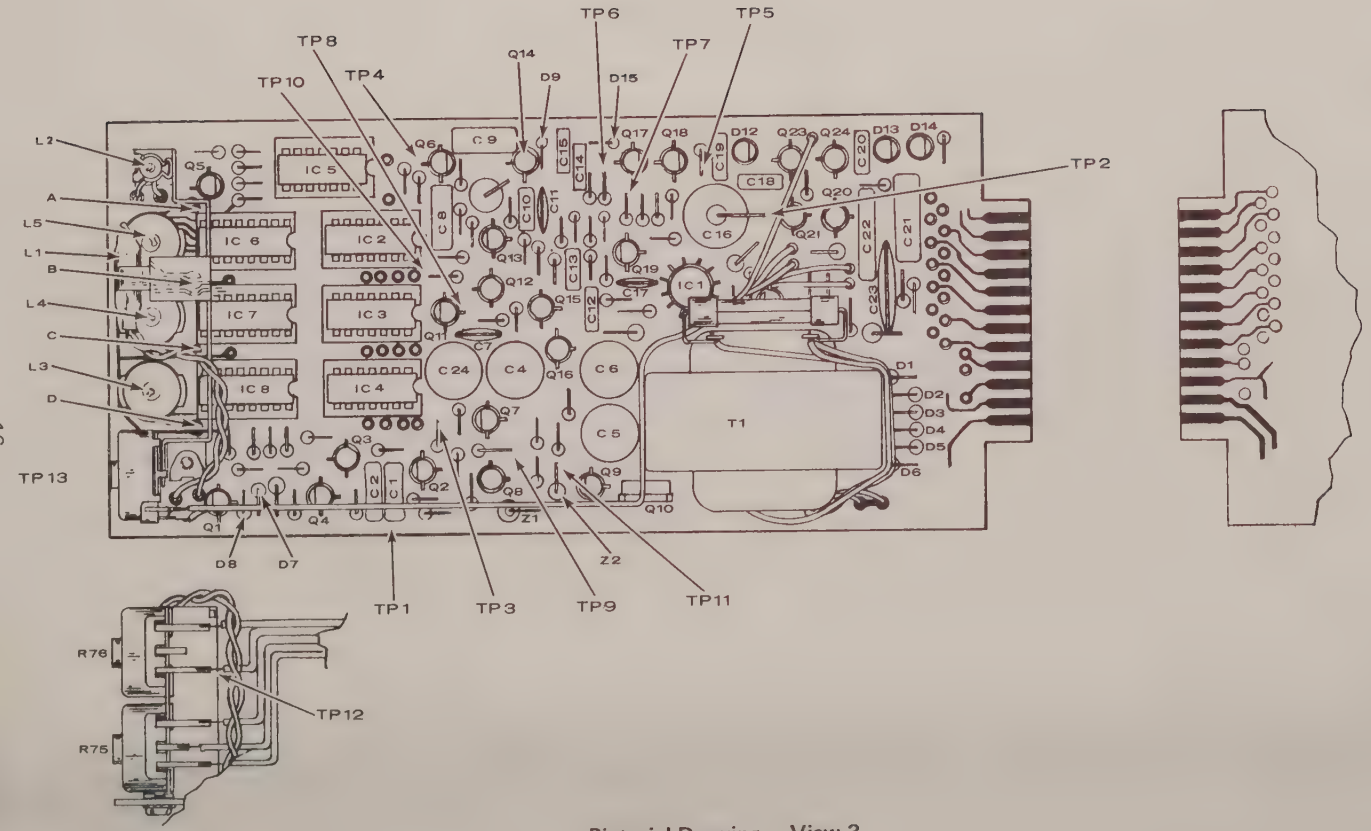


Pictorial Drawing – View 1
Figure 8



Pictorial Drawing – View 2

Figure 8



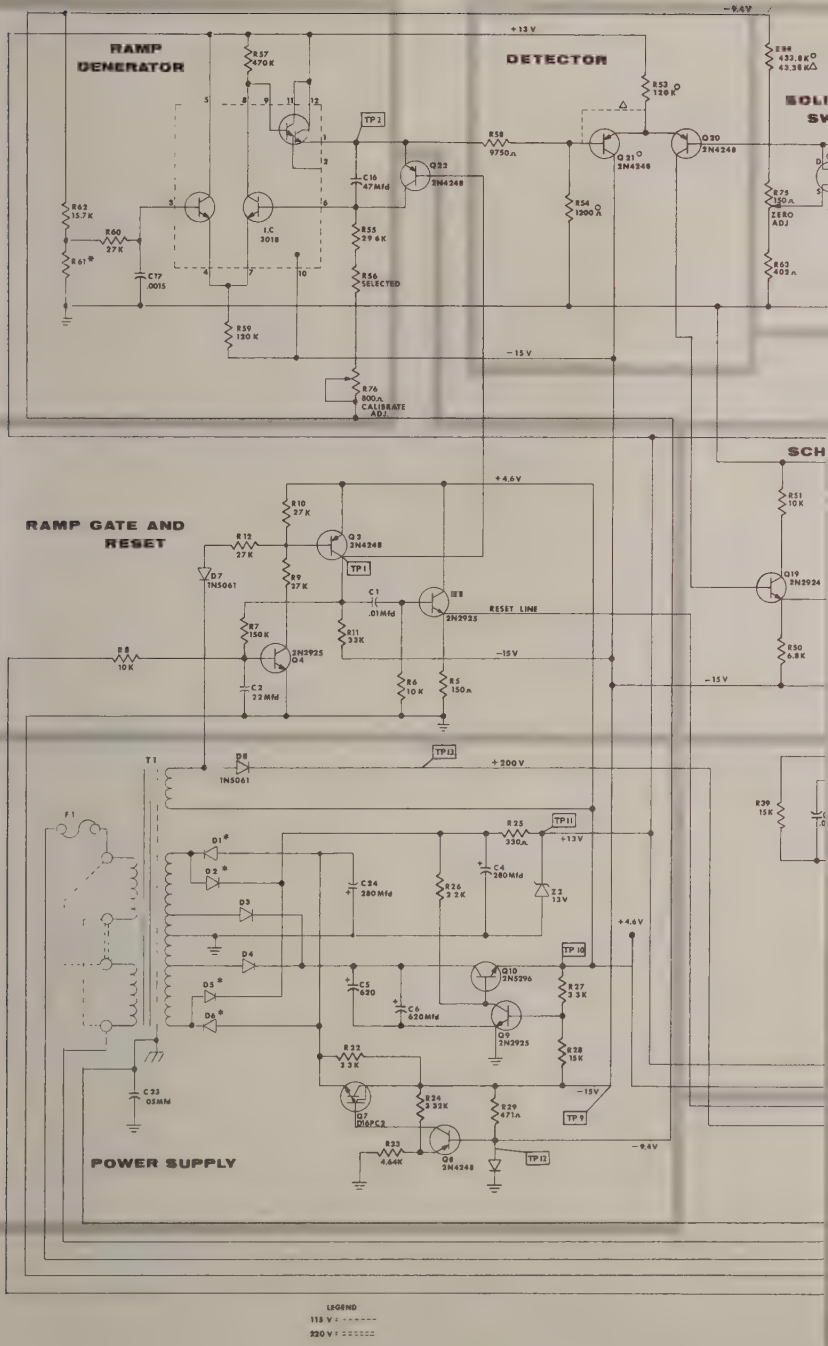
Pictorial Drawing – View 3
Figure 8

Parts List for Series 270 Digital Panel Meters

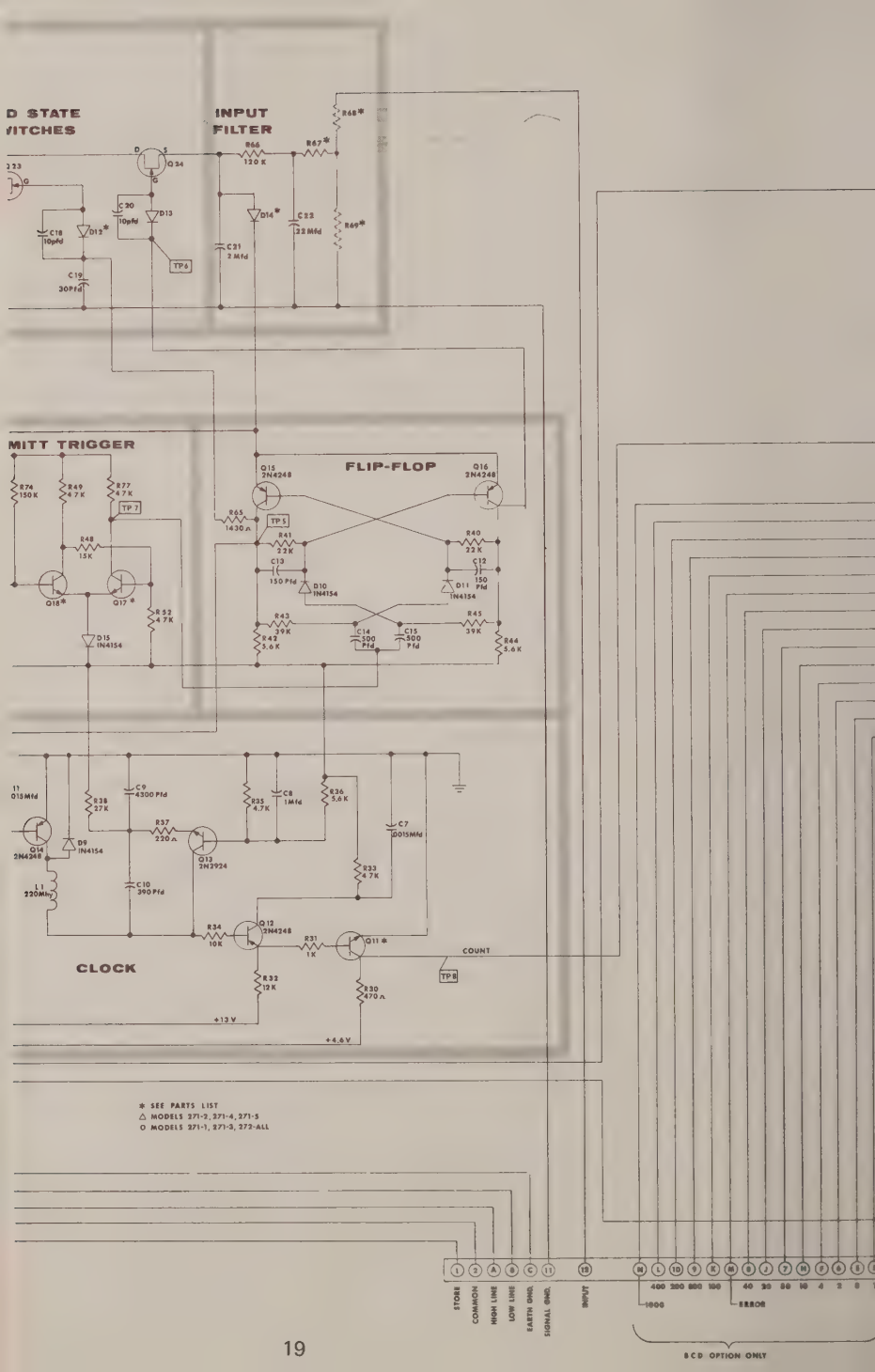
SYMBOL	DESCRIPTION	STOCK NUMBER
R1, 18, 57	Resistor, Carbon, 470K, 1/4W, 10%	55-10101JK470
R2, 43, 45	Resistor, Carbon, 18K, 1/4W, 10%	55-10101JK018
R3	Resistor, Carbon, 18K, 1/4W, 10%	55-10101JK018
R4, 19, 50	Resistor, Carbon, 6.8K, 1/4W, 10%	55-10101JK006R8
R5	Resistor, Carbon, 150 ohm, 1/4W, 10%	55-10101JA150
R6, 8, 34, 51	Resistor, Carbon, 10K, 1/4W, 10%	55-10101JK010
R7, 74	Resistor, Carbon, 150K, 1/4W, 10%	55-10101JK150
R9, 10, 38, 60	Resistor, Carbon, 27K, 1/4W, 10%	55-10101JK027
R11	Resistor, Carbon, 33K, 1/4W, 10%	55-10101JK033
R12	Resistor, Carbon, 27K, 1/2W, 10%	55-10102JK027
R16, 17	Resistor, Carbon, 56K, 1/4W, 10%	55-10101JK056
R20, 31	Resistor, Carbon, 1K, 1/4W, 10%	55-10101JK001
R21, 30	Resistor, Carbon, 470 ohm, 1/4W, 10%	55-10101JA470
R22, 27	Resistor, Carbon, 3.3K, 1/4W, 10%	55-10101JK003R3
R23	Resistor, Fixed, 4.64K, 3/4W, 1%	55-10111ELK004R64
R24	Resistor, Fixed, 3.32K, 3/4W, 1%	55-10111ELK003R32
R25	Resistor, Carbon, 330 ohm, 1/2W, 10%	55-10102JA330
R26	Resistor, Carbon, 2.2K, 1/4W, 10%	55-10101JK002R2
R28, 39, 48, 71, 72, 73	Resistor, Carbon, 15K, 1/4W, 10%	55-10101JK015
R29	Resistor, Precision, 471 ohm, 1W, 0.1%	55-10121BDA471
R32	Resistor, Carbon, 12K, 1/4W, 10%	55-10101JK012
R33, 35, 49, 52, 77	Resistor, Carbon, 4.7K, 1/4W, 10%	55-10101JK004R7
R36, 42, 44	Resistor, Carbon, 5.6K, 1/4W, 10%	55-10101JK005R6
R37	Resistor, Carbon, 220 ohm, 1/4W, 10%	55-10101JA220
R40, 41	Resistor, Carbon, 22K, 1/4W, 10%	55-10101JK022
R53		
Models 271-1, 3 272-1, 2, 3, 4, 5 only	Resistor, Carbon, 120K, 1/4W, 10%	55-10101JK120
R54		
Models 271-1, 3 272-1, 2, 3, 4, 5 only	Resistor, Precision, 1.2K, 1W, 0.1%	55-10121BDK001R2
R55	Resistor, Precision, 29.6K, 1/8W, 0.1%	55-09476
R58	Resistor, Precision, 9.75K, 1W, 0.1%	55-10121BDK009R75
R61		
Models 271-1, 3 272-1, 2, 3, 4, 5	Resistor, Precision, 3.96K, 1W, 0.1%	55-10121BDK003R96
Models 271-2, 4, 5	Resistor, Precision, 2.38K, 1W, 0.1%	55-10121BDK002R38
R62	Resistor, Precision, 15.7K, 1W, 0.1%	55-10121BDK015R7
R63	Resistor, Film, 402 ohm, 3/4W, 1%	55-10111EJA402
R64		
Models 271-1, 3 272-1, 2, 3, 4, 5	Resistor, Film, 433.8K, 3/4W, 1%	55-10111EJK433R8
271-2, 4, 5	Resistor, Film, 43.38K, 3/4W, 1%	55-10111EJK043R38
R65	Resistor, Film, 1.43K, 3/4W, 1%	55-10111ELK001R43
R67		
Models 271-1, 2, 5 272-1, 2, 3, 4, 5	Resistor, Carbon, 100K, 1/4W, 10%	55-10101JK100
Models 271-3, 4	Resistor, Carbon, 22K, 1/4W, 10%	55-10101JK022
R68		
Models 271-3, 4 only	Resistor, Film, 100K, 3/4W, 0.5%	55-10111DJK100
Model 271-5 only	Resistor, Film, 9.9M, 3/4W, 0.5%	55-09470

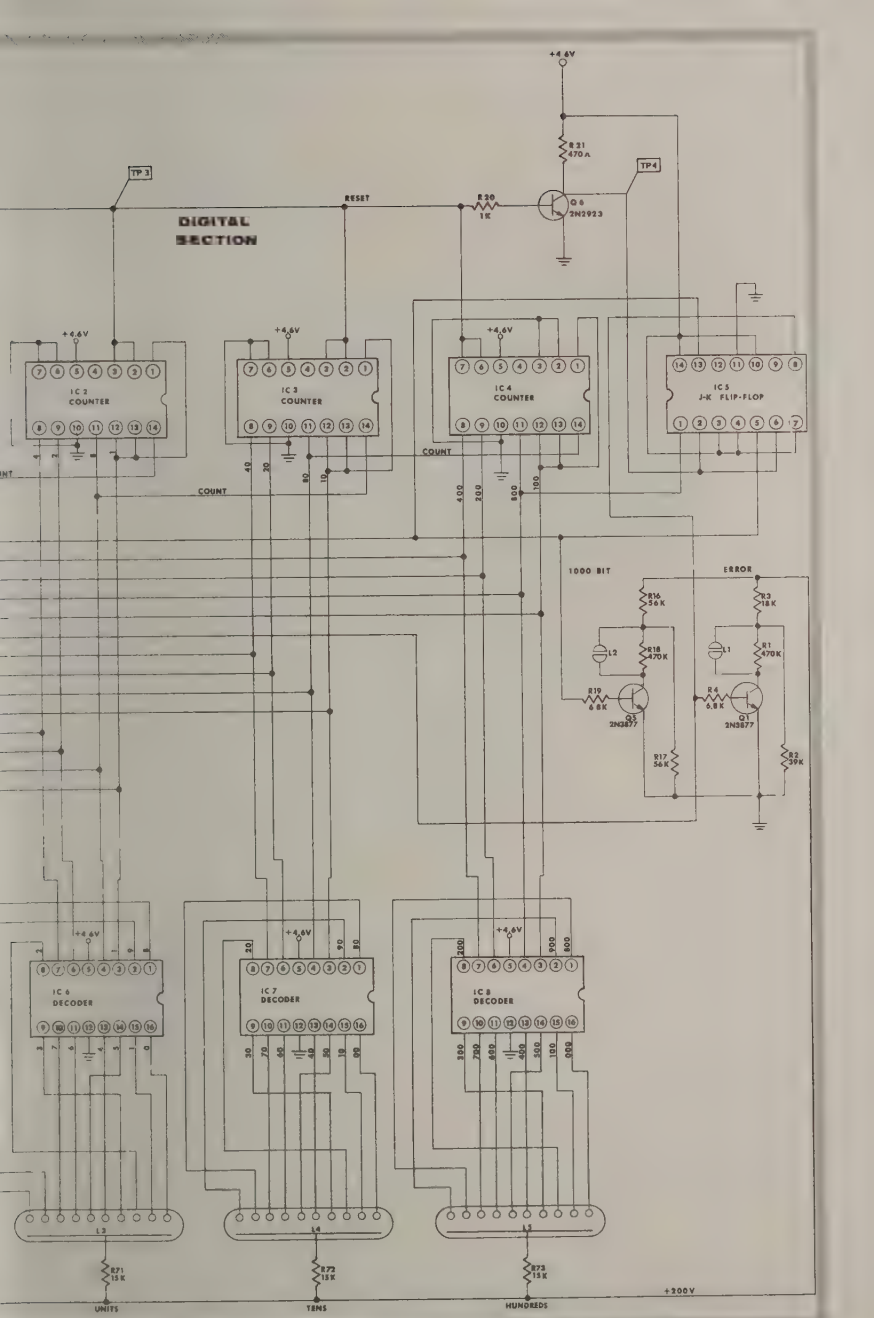
Parts List for Series 270 Digital Panel Meters (Cont.)

SYMBOL	DESCRIPTION	STOCK NUMBER
R69		
Model 272-1	Resistor, Film, 10K, 3/4W, 0.5%	55-10111DJK010
Model 272-2	Resistor, Precision, 1K, 1W, 0.5%	55-10121DDK001
Model 272-3	Resistor, Precision, 100 ohm, 1W, 0.5%	55-10121DDA100
Model 272-4	Resistor, Precision, 10 ohm, 1W, 0.1%	55-10121BDA010
Model 272-5	Resistor, Precision, 1 ohm, 1W, 0.5%	55-10121DDA001
R75	Resistor, Variable Wire, 150 ohm, 2W, 20%	55-10152KA150
R76	Resistor, Variable Wire, 800 ohm, 2W, 20%	55-10152KA800
C1	Capacitor, Mylar, 0.01μfd @ 400VDC	56-10205AYA103J4
C2, 21, 22	Capacitor, Mylar, 0.22μfd @ 200VDC	56-10206BYB224J2
C4, 24	Capacitor, Electrolytic, 280μfd @ 25VDC	56-10216BH287N25
C5, 6	Capacitor, Electrolytic, 620μfd @ 10VDC	56-10216BH627N10
C7, 11, 17	Capacitor Ceramic, 0.0015μfd @ 1000VDC	56-10215A152JT10
C8	Capacitor, Mylar, 0.1μfd @ 200VDC	56-10205BYB104J2
C9	Capacitor, Mica, 4300pf @ 500VDC	56-10210C432FL5
C10	Capacitor, Mica, 390pf @ 500VDC	56-10210A391FL5
C12, 13	Capacitor, Mica, 150pf @ 500VDC	56-10210A151HL5
C14, 15	Capacitor, Mica, 500pf @ 500VDC	56-10210A501HL5
C16	Capacitor, Polystyrene, 0.47μfd @ 100VDC	56-10208EY474FL1
C18, 20	Capacitor, Mica, 10pf @ 500VDC	56-10210A100JL5
C19	Capacitor, Mica, 30pf @ 500VDC	56-10210A300JL5
C23	Capacitor, Ceramic, 0.05μfd @ 600VDC	56-10215H503KT6
1N1	Choke, Inductor	42-09468
D1, 2, 3, 4, 5, 6	Diode, Power, 0.8 amp @ 100PIV	40-07787-01
D7, 8	Diode, Power, 1N5061	40-09463
D9, 10, 11, 15	Diode, Signal, 1N4154	40-09297
D12, 13, 14	Diode, Clipper	40-07199
Z1	Diode, Zener, 1N2166A	40-09069-01
Z2	Diode, Zener, 13V	40-09219-07
Q1, 5	Transistor, High voltage, 2N3877	40-09462
Q2, 4, 9	Transistor, Signal, 2N2925	40-04233-05
Q3, 8, 12, 14, 15, 16, 20, 22,	Transistor, Signal, 2N4248	40-09437
Q6	Transistor, Signal, 2N2923	40-04233-03
Q7	Transistor, Darlington	40-09277
Q10	Transistor, Power, 2N5296	40-09145
Q11, 17, 18	Transistor, Signal, 2N2922	40-04233-02
Q13, 19	Transistor, Signal, 2N2924	40-04233-04
Q21		
Models 271-1, 3, 272-1, 2, 3, 4, 5 only	Transistor, Signal, 2N4248	40-09437
Q23, 24	Transistor, Field Effect	40-07963
IC2, 3, 4	Integrated circuit, counter	40-09465
IC5	Integrated circuit, J-K flip-flop	40-09467
IC6, 7, 8	Integrated circuit, decoder	40-09466
L1, 2	Lamp, Neon	52-07654
L3, 4, 5	Lamp, Nixie	49-09469
F1		
Standard	Fuse, 1/2 amp, slow blow	52-09749-02
'S' Option	Fuse, 1/4 amp, slow blow	52-09749-01



Schematic Diagram
Figure 10


D STATE
WITCHES
INPUT
FILTER
R66
120 K
R67*
R68*
R69*
C18
10pfd
C19
30Pfd
C20
10pfd
C21
2 Mfd
C22
22 Mfd
D12*
D13
D14*
TP6
Q24
MITT TRIGGER
FLIP-FLOP
R74
150 K
R49
4.7 K
R77
4.7 K
TP 7
R48
15K
Q18*
Q17*
R52
4.7 K
D15
1N4154
Q15
2N4248
Q16
2N4248
R65
1430 A
TP 5
R41
22 K
R40
22 K
C13
150 Pfd
C12
150
Pfd
D10
1N4154
D11
1N4154
R43
39 K
R42
5.6 K
C14
300
Pfd
C15
300
Pfd
R45
39 K
R44
5.6 K
C9
4300 Pfd
C8
1Mfd
R36
5.6 K
R38
27K
R35
4.7K
C7
.0015Mfd
R37
220 A
D9
1N4154
Q14
2N4248
Q13
2N3924
R33
4.7K
C10
390 Pfd
L1
220Mhy
R34
10K
Q12
2N4248
R31
1K
Q11*
CLOCK
COUNT
TP8
R32
12K
R30
470 A
+13 V
+4.6 V
* SEE PARTS LIST
△ MODELS 271-2, 271-4, 271-5
O MODELS 271-1, 271-3, 272-ALL
STORE
COMMON
HIGH LINE
LOW LINE
EARTH SIG.
SIGNAL
INPUT
400 200 800 100
1000
40 20 80 10 4 2 8
ERROR
BCD OPTION ONLY


+4.6V
R21 470Ω
TP4
TP3
RESET
R20 1K
Q6 2N2923
DIGITAL SECTION
IC 2 COUNTER
IC 3 COUNTER
IC 4 COUNTER
IC 5 J-K FLIP-FLOP
COUNT
40
20
80
10
400
200
800
100
1000 BIT
ERROR
R16 56K
R3 18K
L2
R18 470K
L1
R1 470K
R19 6.8K
Q3 2N3877
R4 6.8K
Q1 2N3877
R17 56K
R2 39K
IC 6 DECODER
IC 7 DECODER
IC 8 DECODER
L3
L4
L5
R71 15K
R72 15K
R73 15K
UNITS
TENS
HUNDREDS
+300V

MP MASTER
MA26222

1220681K

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